Benefits and Costs of Advanced Motor Vehicle Technologies

1997 SAE GOVERNMENT/INDUSTRY MEETING

May 7, 1997

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Introduction

- Analytic Purpose
- Modeling Process and Results
  - Vehicle Choice/Attributes
- Economic Consideration
  - Energy Security
  - Emissions
  - GPD and Jobs
- Benefit/Cost Results

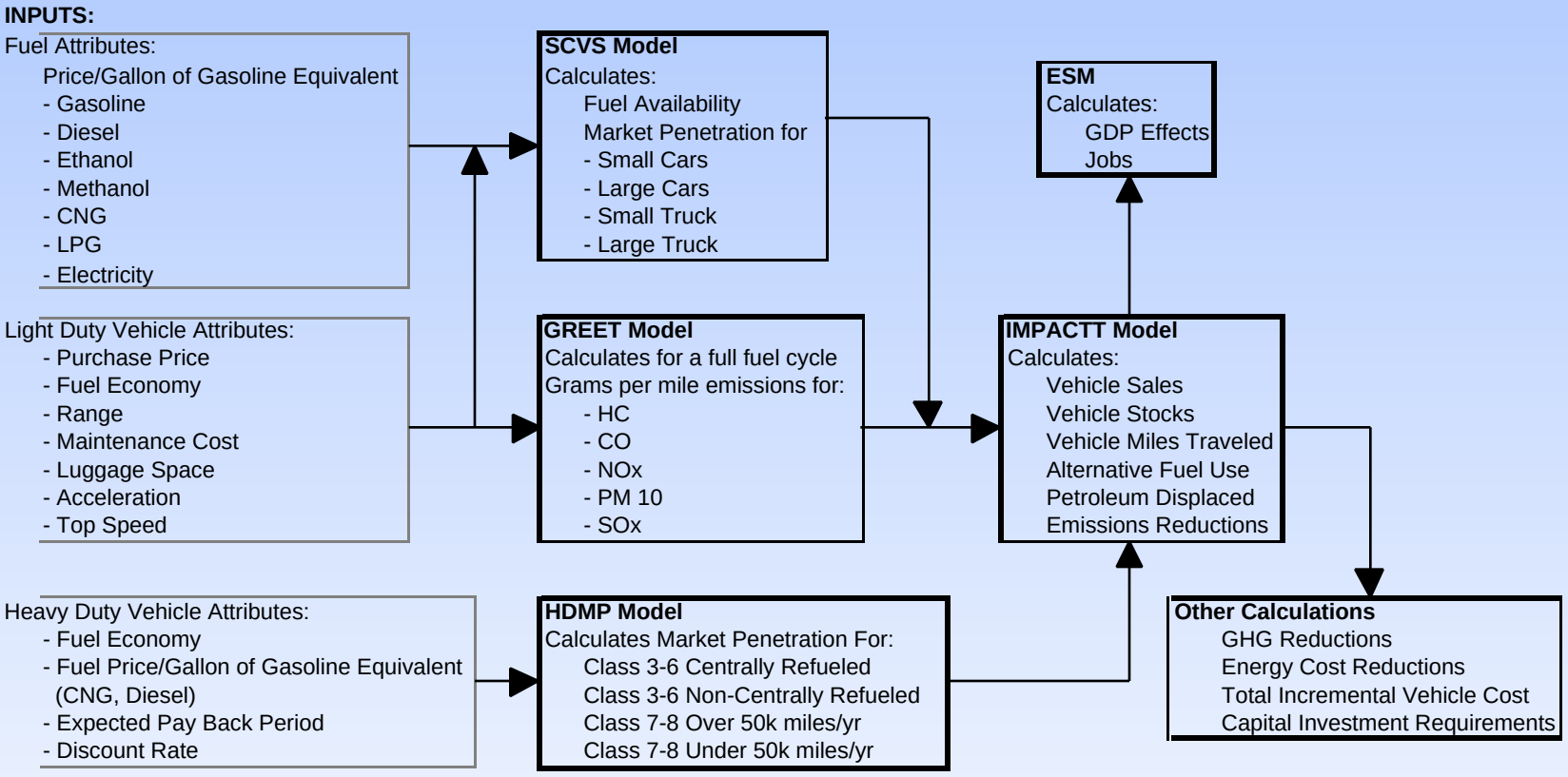
Analytic Purpose

- Benefit/Cost Evaluation of R&D Programs
  - The Three E's vs. Gov't Spending
- Strategic Planning
  - Scenario Analyses
    - Individual Technologies
    - Efficiency vs. Alternative Fuels

Benefit and Cost Perspective

- Societal
  - Energy Security, Environmental, Economic
- Consumer
  - Perceived Value of Vehicle Attributes
- Manufacturer
  - Capital Investment and Payback

Modeling Process



KEY:

SCVS - Size Class Vehicle Sales Model
GREET - Greenhouse Gases, Regulated Emissions, and Energy Use in Transportation Model
IMPACTT - Integrated Market Penetration and Anticipated Cost of Transportation Technologies Model
HDMP - Heavy Duty Market Penetration Model
ESM - Employment Spreadsheet Model

Survey Results: Unit Equivalent Values per $1000

	Small Car	Passenger Truck
MPG	5.4	2.0
Range (miles)	56	28
Acceleration (0 to 30 mph)	-1.3	-0.64
Top Speed	18	NA
Luggage Space	14%	3%

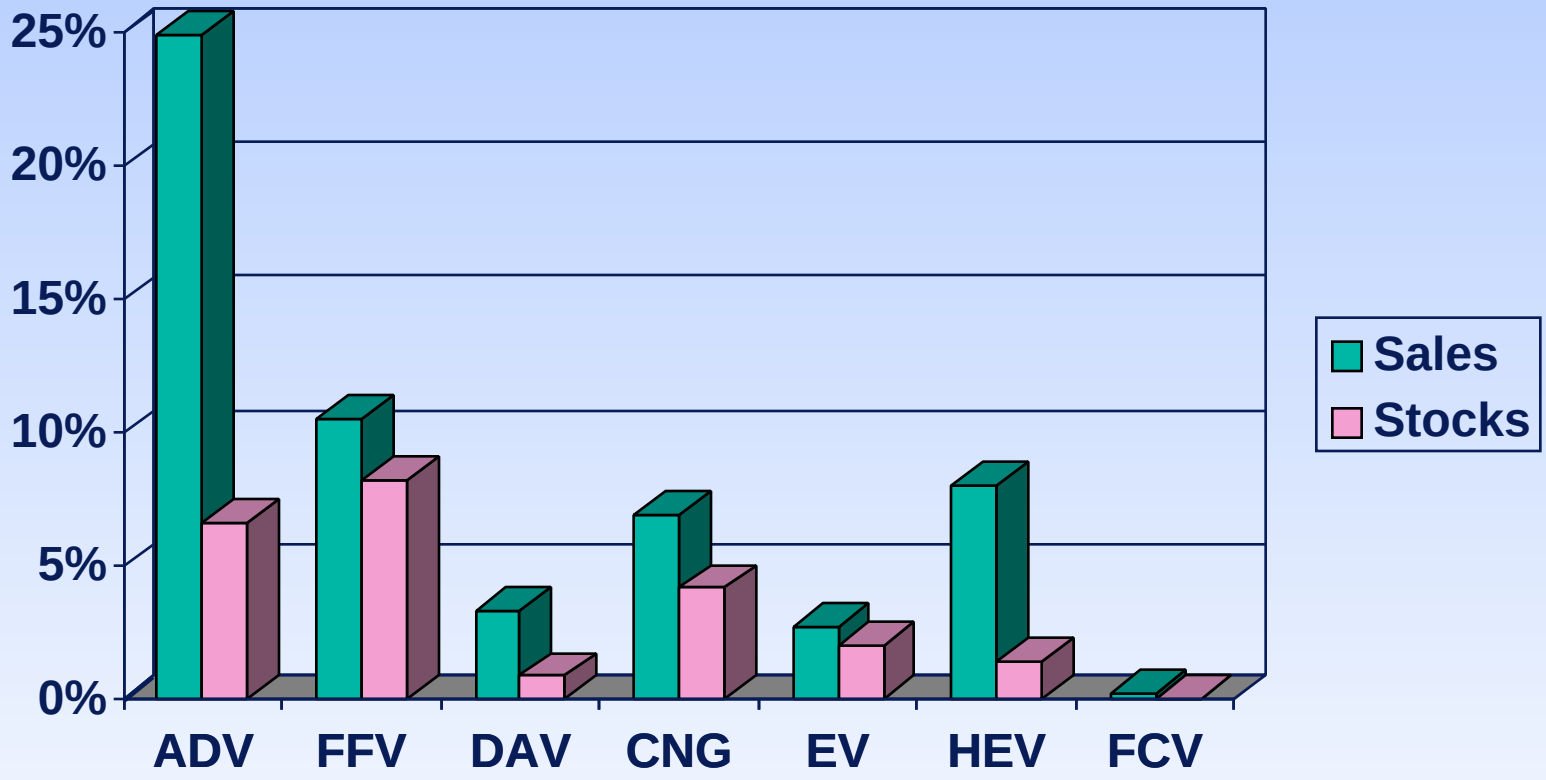
Advanced Vehicle Price Passenger Truck

	Diesel	Electric	Hybrid	Fuel Cell
Year of Intro.	2003	1999	2011	2013
Year of Matur.	2008	2015	2015	2013
Intro. Price	1.15	2.00	1.25	1.30
Matur. Price	1.10	1.15	1.20	1.30

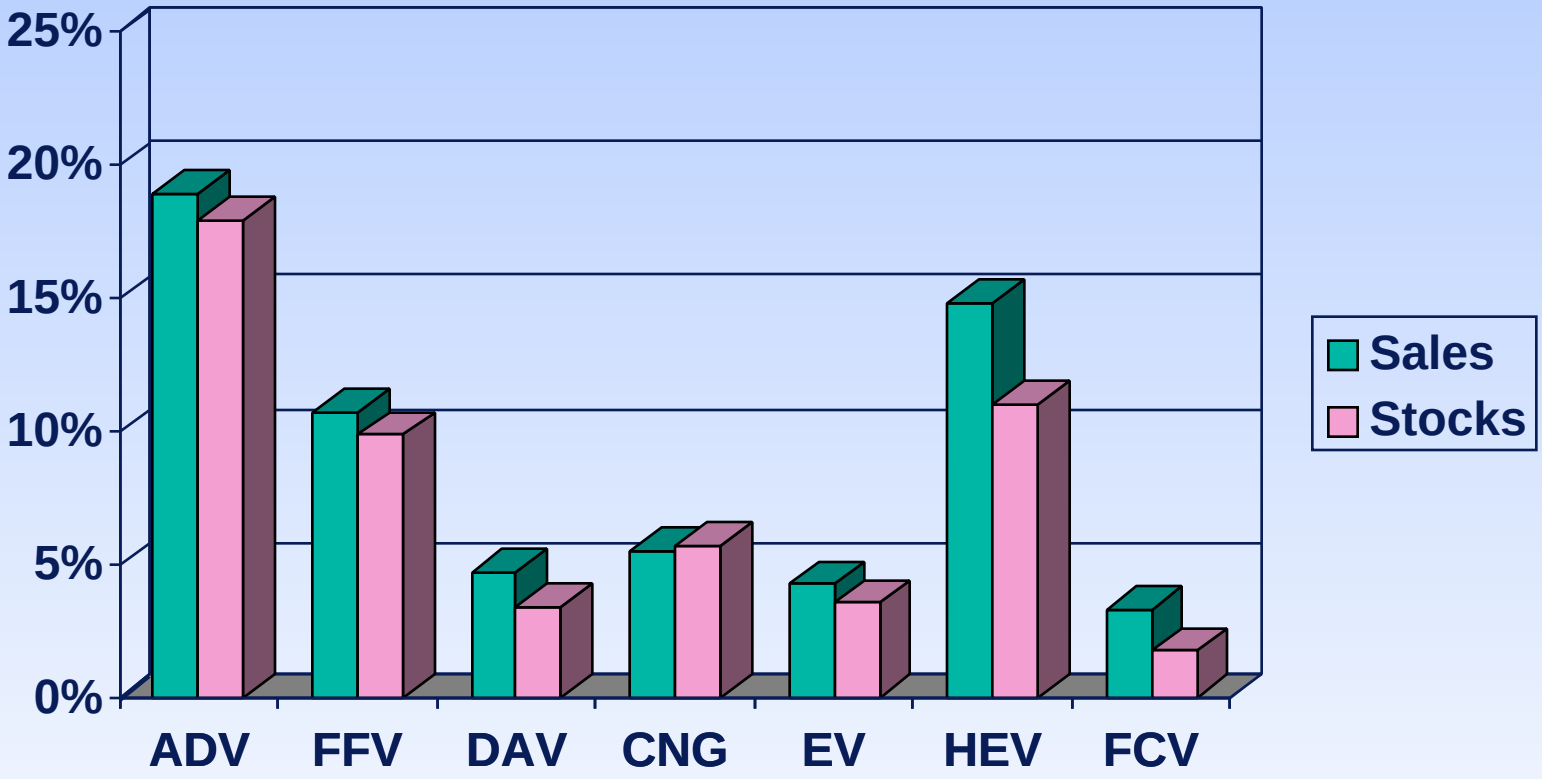
Advanced Vehicle MPG Passenger Truck

	Diesel	Electric	Hybrid	Fuel Cell
Year of Intro.	2003	1999	2011	2013
Year of Matur.	2008	2015	2015	2013
Intro. MPG	1.15	4.0	1.4	2.5
Matur. MPG	1.25	4.0	2.1	2.5

2010 Light Duty Vehicle Market Penetration



2020 Light Duty Vehicle Market Penetration



Primary Oil Displaced

million barrels per day	2010	2020
Advanced Diesel	0.03	0.11
Electric	0.11	0.18
Hybrid	0.05	0.38
Fuel Cell	0.00	0.09
CNG	0.42	0.45
Biofuels	0.36	0.65
Heavy Vehicles	0.09	0.22
Total	*1.07*	*2.08*

Carbon Emission Reductions

mmtons CO^2 Carbon Equivalents	2010	2020
Advanced Diesel	1.3	4.0
Electric	0.0	0.0
Hybrid	2.1	15.2
Fuel Cell	0.0	2.9
CNG	4.4	4.7
Biofuels	14.5	26.0
Heavy Vehicles	3.4	8.5
Total	*25.7*	*61.3*

Criteria Emission Reductions

thousand tonnes	2010	2020
NO_X	65.0	30.8
CO	2849.0	8010.0
HC	208.7	525.7

Criteria Values

Energy Security	$4 per barrel
Carbon Monoxide	$300 per tonne
Hydrocarbons	$3,050 per tonne
Nitrogen Qxides	$2,750 per tonne
Carbon Dioxide	$15 per ton

Economic Spreadsheet Model

- Tracks Cash Flows Related to Penetration of Advanced Technologies
- Flows Include:
  - Incremental Vehicle Costs
  - Changes in “Baseline” Consumer Spending
  - Alternative Fuel Costs
- Cash Flows Are Multiplied by Job and GDP Multipliers

ESM: Job and GDP Multipliers

	Job Multipliers (Jobs per $M)	GDP Multipliers ($M GPD per $M)
Agriculture	26.86	2.12
Refining	7.14	2.02
Oil and Gas Extraction	7.02	1.34
Gas Utility	7.41	1.99
Electric Utility	9.54	1.78
Motor Vehicles	13.70	2.19
Household	16.80	1.47
Wholesale Trade	20.43	1.47

Employment Impacts

Thousands of Jobs	2010	2020
Advanced Diesel	4.0	21.6
Electric	10.6	26.5
Hybrid	(11.3)	43.3
Fuel Cell	(1.1)	(2.8)
CNG	32.9	29.0
Biofuels	27.8	74.8
Heavy Vehicles	(11.5)	21.9
Total	*51.4*	*214.3*

GDP Impacts

Million 1994 $	2010	2020
Advanced Diesel	726	601
Electric	2,404	2,343
Hybrid	4,400	7,637
Fuel Cell	233	2,723
CNG	1,798	3,935
Biofuels	3,207	3,615
Heavy Vehicles	4,236	14,428
Total	*17,004*	*35,282*

Cumulative Benefits and Costs

Billion 1994 $	2010	2020
Budget Costs	2	2
Benefits	48.9	349.2
Energy Savings	*31.4*	*202.9*
Oil Security	*1.2*	*4.2*
Fuel Price Changes	*7.2*	*12.9*
Pollution Reduction	*11.2*	*70.4*
Incremental Costs	*(122.4)*	*(377.8)*
GDP Benefits	*120.3*	*436.7*
Benefit to Cost Ratio	24.5	174.6

Closing Remarks

- Dynamic Modeling Process
  - New Vehicle Choice Model
  - Updated Total Fuel Cycle and Emissions
- Peer Reviewed
- Technology Attributes Reflect Program Goals